

# Comparator & RA Verification

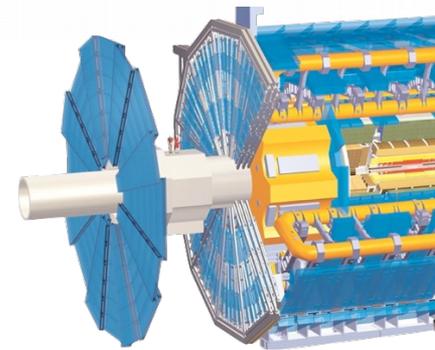
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Feb 17, 2017

	DTC1	Single-phase DTC (Chen-Kai's design)	Double-Regen (DTC2)
<b>Avg. Power @ 320 MHz</b>	103.5 $\mu$ W	78.83 $\mu$ W	102.3 $\mu$ W
<b>Prop. Delay <math>t_{CLK \rightarrow OUT}</math></b>	210 pS	130 pS	127 pS
<b>P[correct] n=1000</b>	96.6 %	91.9 %	96.5 %
			97.2 % @ 120 $\mu$ W
<b>Input-referred <math>\sigma</math> ("input-ref. noise")</b>	189 $\mu$ V	229 $\mu$ V	190 $\mu$ V
<b><math>\Sigma C_{fn}</math></b>	98.178 fF	24.07 fF	69.37 fF
<b>Input transistor gate area (pre-layout), per transistor</b>	1.04 $\mu$ m <sup>2</sup> L = 130 nm	2.88 $\mu$ m <sup>2</sup> L = 60 nm	4.16 $\mu$ m <sup>2</sup> L = 130 nm

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<b><math>\Delta V_{th}</math> Input Diff Pair std. Dev. M.C. n=1000</b>	--	22.31 mV	18.75 mV

- Transient simulation is great, but ...
- Wanted to check against PSS simulation as a sanity check
  - Gain: PAC **7.18 V/V**
  - Noise: Pnoise (especially useful!) **254 uVrms sum**
  - Input offset: **15.91 mV** ( $\Delta V_{th}$  std. Dev. M.C. n=1000)



# Rad-~~Hardening~~ Calibration

- Neutrons of  $>20$  MeV
- Non-ionizing  $\rightarrow$  doesn't directly interact with electrons
- Generally, neutrons  $\rightarrow$  nucleus(Si, SiO<sub>2</sub>)  $\rightarrow$  ionizing radiation
- Two possible mechanisms:
  - Neutron  $\rightarrow$  nucleus  $\rightarrow$  gamma ray  $\rightarrow$  LET/EHP
  - Neutron  $\rightarrow$  nucleus  $\rightarrow$  ejected (!!) proton  $\rightarrow$  LET/EHP
- LET/EHP deposits charge in predominantly caps and FETs

- Have detector structures underneath SAR caps to detect SEU's (and possibly their energies) for calibration purposes
  - Cap array: “CCD”
  - Diode array: “photodiode”
- Guidelines
  - Pixel-like layout directly beneath SAR caps (e.g. common centroid layout)
  - Needs to be minimum parasitic to SAR
  - Put SAR caps closest to top metal
  - Requires metal and silicon directly beneath SAR caps
  - Additional pads for readout (~10?)

- SAR design
  - DTC2 layout
  - Reference buffer?
  - SAR cap layout (for rad-cal)
- Rad-Cal
  - Geant4 physics simulations
  - Determine LET for gamma and proton
  - Convert that to a voltage perturbation
  - Design readout electronics
  - Integrate sensor layout into SAR cap layout
  - Extract parasitics on SAR cap layout to verify